23. Factors Influencing the Voluntary Intake of Food

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Learning objectives

On completion of this topic you should be able to:

• Appreciate the importance of knowing the voluntary intake of food by ruminants in the particular circumstances of grazing, as compared with penned or feed-lot animals
• Understand the difference between the factors that are animal attributes and those that are feed attributes
• Understand the importance of distinguishing between the mature size, stage of maturity and body condition of the animal in assessing its potential intake of food
• Understand the effects of feed quality and feed availability and their interaction with selective grazing
• Understand the principles of substitution when supplements are fed to grazing animals

Key terms and concepts

Voluntary intake, potential intake, relative intake, mature size, feed availability, substitution rate.

Introduction to the topic

The productivity of animals is determined mainly by the amount of food they eat and, although there are times when intake is deliberately restricted so as to merely maintain animals or to eke out sparse resources, the usual aim of management is to allow the animal to achieve the maximum intake for the particular feeding situation. This level is known as the animal’s voluntary intake of the feed and is measured in kg of dry matter per day (kg DM/d) because of the wide variation in feed DM%, e.g. from <15% to >60% in herbage. For hand-fed animals in feedlots or dairies, the main reason for wanting to know their voluntary intake is to ensure that a weighed ration of a formulated diet is within the animal’s capacity. Most other ruminants in Australia subsist almost entirely on grazed pasture and here the situation is quite different.

Pastures are in a continual state of change in the amount and quality of the diet they offer the grazing animal, from one that will allow a voluntary intake sufficient to support rapid weight gains to one that will barely maintain the animal; optimal management may then require supplementary feeding or movement to alternative grazing. Although a rational management decision depends on knowing their voluntary intake from the pasture they are on, it is virtually impossible to measure this directly and laborious and time-consuming to estimate it indirectly. This has led to the development of systems for predicting voluntary intake, based on an analysis of the factors that are thought to control it. These systems aim to integrate the results of many decades of experimental work on the effects of these factors. One system, designed specifically for grazing animals, is implemented in the GrazFeed decision support tool, which is described by Freer et al. (2005). Recent reviews by Weston (1996; 2002) provide further references to much of the work summarized in this lecture.

23.1 The regulation of voluntary intake

At the level of the central nervous system, intake regulation is a balance between hunger signals to the brain that indicate an energy deficit in relation to the animal’s capacity to use energy and satiety signals that indicate that the digestive tract has reached a limiting load. With the diets usually fed to non-ruminants it is common for intake to be limited mainly by the energy content of the diet. But in ruminants, which have evolved to subsist largely on low-energy roughage diets that are bulky and very slow to break down in the rumen, voluntary intake is limited more by the rate at which this gut load can be cleared, through particle breakdown by rumination and microbial action.
In attempting to integrate the factors that control voluntary intake in a particular situation, it is convenient to regard voluntary intake as the product of two components, the potential intake (kg DM/d) by the animal and the relative intake offered by the feed supply, as a proportion of potential intake.

23.2 Potential intake of feed by the animal

Potential intake is defined as the amount eaten when the animal is offered abundant feed and is able to select a diet with a dry matter digestibility (DMD%) of at least 80%. This upper limit to voluntary intake is set by some combination of the animal’s potential demand for energy and its physical capacity for feed, both of which are clearly proportional, in a general way, to the size of the animal. However, current weight is not a useful predictor of body size as it confounds differences in mature size with stage of development and body condition. The system to be described here for predicting potential intake includes these three components as separate factors and then considers the modifying effects of the physiological state of the animal, climatic extremes and animal health.

Figure 23.1 Predicted potential intake of sheep with SRW = 50 kg (solid line) or 40 kg (dotted line) and cattle with SRW = 500 kg (solid line) or 400 kg (dotted line) in relation to relative size, for animals with relative condition ≤1.0.

Source: Freer, Moore and Donnelly (2005).

Animal size and condition

Mature size (commonly referred to as the Standard Reference Weight or SRW) is defined as the weight of the animal when it has reached mature skeletal size and has a body condition score in the middle of the range. A medium Merino ewe for example might have an SRW of 50 kg and a Hereford cow an SRW of 500 kg, but these values will vary depending on the breeding policy in the flock or herd. The relative size of an immature animal is estimated as the ratio of its weight (in average condition) to its SRW (with an upper limit of 1.0). The relative condition of an animal is estimated as the ratio of its current weight to its weight in average condition, e.g. an animal that is 10% heavier than when in average condition has a relative condition of 1.1.
Results from a wide range of experiments suggest that equation 1 provides a reasonable way of integrating the effects of mature size, $M$, relative size, $Z$, and relative condition, $C$ to predict voluntary intake, $I$ (kg DM/d).

$$I = b M Z(1-Z) F$$  \hspace{1cm} (1)

where: $b$ has suggested values of 0.04 for sheep and 0.025 for cattle

$$F = \begin{cases} 
C(1.7 - C)/0.7 & \text{if } C > 1.0 \\
1.0 & \text{otherwise}
\end{cases}$$

Examples of predictions for sheep and cattle in average condition are shown in Fig. 23.1, from which it is clear that potential intake reaches a peak at 85% maturity, when the animal's energy demand is at its highest. Values at a range of weights in growing animals are shown in Table 23.1. Potential intake does not increase once the animal is mature and will fall with increasing body condition if feed consumption continues at this level. The effects of a much wider range of conditions can be tested by going to the ‘Potential intake’ worksheet of either SheepExplorer or CattleExplorer on the website: www.pi.csiro.au/grazplan.

**Physiological state**

**Pregnancy**

The development of the conceptus requires an exponential increase in the additional energy demand of the animal but the potential intake of food does not increase. This is thought to be because the increasing space occupied in the body cavity restricts the capacity of the reticulo-rumen. Indeed, feed intake is maintained at the earlier level only by a faster rate of clearance of digesta from this organ. The decline in intake that is usually observed during the last few days of gestation is probably related to endocrinological changes.

**Lactation**

Potential intake increases in proportion to energy demand during lactation but lags behind it in time as the capacity of the reticulo-rumen slowly increases after parturition. A peak or plateau in intake is not reached until about 4 months after calving or about 6 weeks after lambing, a situation that obviously has important consequences for the maintenance of the energy balance of the lactating animal. In high yielding dairy cows, the peak value may be more than double that of the dry cow, in beef cows or ewes with one lamb there may be a 50% increase and in ewes with twins an 80% increase. As the lactation progresses, the increase in intake follows a similar pattern to the lactation curve and will be depressed if milk production is restricted by poor feed supply or low body condition, particularly at parturition. An example of this pattern for lactating ewes is shown in Fig. 23-2; the intake factor predicted here is used as a multiplier for potential intake in equation 1. Again, a wide range of conditions for ewes and cows may be tested in the Explorer programs for their effects on this multiplier.

**Unweaned young**

The potential intake of solid food by unweaned lambs and calves in the first few weeks of life depends on rumen development rather than body weight. The appropriate proportion, $s$, of the potential intake that would be calculated from equation 1 is predicted from equation 2 and again the value is used as a multiplier in the earlier equation.

$$s = (1.0 - P_{milk})/(1.0 + \exp(-a(T - R)))$$  \hspace{1cm} (2)

where $P_{milk}$ = proportion of the diet from milk  
$T$ = age (days)  
$R$ = 25 d for lambs or 60 d for calves  
$a$ = 0.5 for lambs or 0.22 for calves

**Climatic factors**

Climatic factors leading to thermal stress in the animal will also affect voluntary food intake, but the response will depend on the extent of insulation and level of metabolic activity of the animal and on the quality of the diet. Indoor studies show a consistent increase or decrease in food intake as the ambient temperature falls or rises, respectively, beyond the thermal neutral zone of the particular animal. However, few measurements have been made under grazing conditions, where the
flexibility of grazing behaviour allows animals to mitigate the effects of climatic extremes and it is difficult to make predictions for grazing animals. The adjustment for high temperatures that is used in the GrazFeed program operates when the average daily temperature exceeds 25°C and the night temperature exceeds 22°C. The potential intake of herbage by cattle, other than Brahman types, is then reduced by 2% for each rise of 1°C in average daily temperature (Fox 1987); for other stock the reduction is 1% per °C. If the ambient temperature falls below the animals lower critical temperature, potential intake is increased by 1% per °C (Fox 1987); an effect that is reduced with rainfall, to disappear at 20 mm per day.

Figure 23.2 The multiplier factor for potential intake of feed by lactating ewes with twin lambs (solid line) or single lambs (dotted line). Source: Freer, Moore and Donnelly (2005).

**Diseases**

Diseases reduce the potential intake of the animal and parasitic infestations are of particular relevance to grazing animals. Tests with different intestinal parasites indicate a complex pattern of responses depending on the level of infection and the development of resistance (Coop and Sykes, 2002) and, as a result, it is not possible at present to make quantitative predictions.

Table 23.1 Predicted mean potential intake (kg DM/d) by growing sheep and cattle of different Standard Reference Weight (SRW) Source: Freer, Moore and Donnelly (2005).

<table>
<thead>
<tr>
<th>SRW (kg)</th>
<th>Weight of animal (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Sheep</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>1.00</td>
</tr>
<tr>
<td>50</td>
<td>1.08</td>
</tr>
<tr>
<td>60</td>
<td>1.14</td>
</tr>
<tr>
<td>70</td>
<td>1.18</td>
</tr>
<tr>
<td>80</td>
<td>1.21</td>
</tr>
<tr>
<td>90</td>
<td>1.23</td>
</tr>
<tr>
<td>Cattle</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>6.3</td>
</tr>
<tr>
<td>500</td>
<td>6.8</td>
</tr>
<tr>
<td>600</td>
<td>7.1</td>
</tr>
<tr>
<td>700</td>
<td>7.4</td>
</tr>
<tr>
<td>800</td>
<td>7.6</td>
</tr>
<tr>
<td>900</td>
<td>7.7</td>
</tr>
</tbody>
</table>

**23.3 Relative intake offered by the feed supply**

For a stall-fed animal, relative intake or the proportion of the potential intake that can be achieved depends almost solely on features of the chemical composition of the diet that restrict its intake (relative ingestibility). For grazing animals, the same restriction to potential intake with, in addition, restrictions set by the physical features of the sward that limit the animal's ability to harvest herbage in the time it has available for grazing (relative availability). If a pasture were a homogeneous mass of plant material with single values for these chemical and physical
characteristics, relative intake would be simply the product of relative ingestibility and relative availability. But it’s not as simple as this; the calculation must take into account the selective grazing that will occur in a heterogeneous sward and the effect of this on nutrient intake.

Table 23.2 Effect of maturation on the attributes that affect relative ingestibility and voluntary intake of phalaris and subclover by sheep.

Source: Freer, Moore and Donnelly (2005).

<table>
<thead>
<tr>
<th>Stage of maturity</th>
<th>Phalaris</th>
<th>Sub clover</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Early</td>
<td>Mid</td>
</tr>
<tr>
<td>Cell wall constituents, CWC (% OM)</td>
<td>44</td>
<td>63</td>
</tr>
<tr>
<td>Digestibility of CWC (%)</td>
<td>82</td>
<td>76</td>
</tr>
<tr>
<td>Time spent chewing (min/kg)</td>
<td>530</td>
<td>840</td>
</tr>
<tr>
<td>Voluntary intake of OM (g/d)</td>
<td>1067</td>
<td>933</td>
</tr>
</tbody>
</table>

a Hogan et al. (1969)
b Weston and Hogan (1971)

Relative ingestibility

Within an upper limit set by the energy demand of the animal, the main characteristics of plant material that determine its intake by ruminants are those that limit the rate at which it can pass through the gut. About 70% of the digesta are in the reticulo-rumen, from which they disappear by microbial digestion and by onward passage through the reticulo-omasal orifice when the feed particles are sufficiently small (ca. 1 mm) and dense to flow out in the fluid phase. The rate of breakdown of the feed, through chewing (during eating and rumination) and microbial action, depends very largely on chemical and physical features of the structural carbohydrates in the plant tissue that change as the plant matures. Progressive crystallization and lignification of the cell wall material make the feed more and more resistant to breakdown, increase the time spent chewing per kg of food and reduce relative ingestibility (see Table 23.2).

These chemical changes that affect the clearance rate of digesta from the rumen are crudely reflected in the overall apparent digestibility of the diet (Table 23-2), a characteristic that is much more readily estimated than the cell wall structure and has been used widely as a predictor of relative ingestibility. A review (Freer, 1981) of several experiments with different pasture species fed to sheep and cattle in pens, showed a linear relationship between apparent digestibility and voluntary intake over the full range of maturity to be found in herbage (digestibility from 30% to >80%). For a 50 kg SRW sheep, voluntary intake increases at about 20-25 g DM per unit increase in digestibility and the relationship appears to be proportionately the same for cattle (Hodgson, 1977). Variation in this relationship occurs between different pasture species and also if the diet is deficient in specific nutrients essential for microbial activity in the rumen.

Figure 23.3 Mean estimates of the relative ingestibility of tropical and temperate grasses and legumes in relation to dry matter digestibility.

Source: Freer, Moore and Donnelly (2005).
Species differences
When different pasture species have been compared, the slope of the regression of relative ingestibility on digestibility has been similar but there are significant differences in the intercept values (see Fig. 23-3). One of the main examples is the greater intercept for most pasture legumes (ca. 0.17 on the relative ingestibility scale) compared with temperate grasses. There is no suggestion here of a dietary preference for legumes (the evidence for that is quite equivocal), merely that digesta from legumes are broken down more rapidly in the rumen and therefore have a higher clearance rate. This enables a greater intake of feed, depending on the proportion of legume in the available herbage. The effect will diminish with herbage weight as declining availability becomes more important than gut clearance rate in constraining intake.

There is rather less information available for tropical herbage species but measurements made with a range of tropical grasses, which have evolved a C4 pathway in photosynthesis, rather than the C3 pathway in temperate grasses, show some distinct differences. Although the digestibility of C4 grasses is, on average, about 15 percentage units lower than that of temperate grasses at the same level of maturity, relative ingestibility is correspondingly higher at the same digestibility (Minson, 1982; D. B. Coates, pers. comm.; Fig. 23-3). However, it is more difficult to generalize about the ingestibility of tropical grasses because of the wider range of morphological features (e.g. buffel grass vs. paspalum) compared with temperate grasses.

Nutrient deficiencies
Relative ingestibility may be depressed if the diet is deficient in certain chemical constituents, particularly those that are essential nutrients for the rumen microbial population, on which the optimum clearance rate of the digesta depends. The most common deficiency is in rumen-degraded protein (RDP), made up of nitrogenous compounds that can supply the ammonia essential for microbial synthesis. The requirement for RDP ranges between 7 and 11 g/MJ of the metabolizable energy (ME) intake that is fermentable in the rumen, i.e. after deducting the ME in fat, undegraded protein and silage acids. If the RDP intake is less than the requirement, feed intake will fall and the microbial population will be maintained at a lower level of activity by the recycling of circulating urea back into the rumen.

In practice, deficiencies in protein may be expected with diets containing less than about 6% crude protein, depending on the level of degradability. Intake levels may be restored by feeding supplements containing adequate RDP or by feeding urea if this is supplied in such a way that its intake can be spread over a long period. Responses to N will not occur if there is inadequate sulphur in the diet and it is suggested that 0.07g S (for cattle) or 0.08 g S (for sheep) is required per g N (i.e. per 6.25 g RDP) in the diet.

In some cases, intake has also responded to the correction of deficiencies in sodium, cobalt or selenium.

Relative availability
Herbage weight and height
For a housed animal or for a sheep grazing a pasture containing at least 2 tonnes of herbage DM/ha (about 3 t DM/ha for cattle), the intake of feed is determined solely by the factors so far considered: potential intake and relative ingestibility. However, to the extent that the weight of herbage falls below these levels, it becomes progressively more difficult for the grazing animal to satisfy its potential intake in the time that it can afford to spend on this activity in each day. We can quantify this change as a decline in the relative availability of the feed, so that relative intake then becomes the product of relative ingestibility and relative availability. Intake is the product of the rate of eating (R, g DM/min) and the time spent eating (T, min/day) and we can consider the impact of declining herbage weight on the relative values of R and T.
When abundant pasture is available, both $R$ and $T$ have a relative value of 1.0. Measurements made by Alden and Whittaker (1970) and others show that, as the weight of herbage falls $R$ decreases and $T$ increases, allowing complete compensation for a while. But although $R$ may decrease without limit, $T$ will usually increase by no more than 60%, with the result that the product, relative availability, is progressively reduced, as shown in Fig. 23.4. These values will vary with animal and pasture conditions; $R$ will vary with mouth size, $T$ will vary with energy demand, lactating ewes for example may graze for up to 14 h/d compared with perhaps 7 h for dry ewes.

A more fundamental variation results from differences in sward structure. Availability to a grazing animal is obviously as much a function of herbage height as weight. Most of the results incorporated in Fig. 23-4 were derived from temperate pastures with a mean height of about 3 cm per tonne DM/ha. A pasture of isolated lucerne plants or a grass pasture in a low rainfall area may have a height of 10 cm/tonne or more, increasing its relative availability at a given weight, and the reverse will be the case for a dense short pasture. An examination of the Relative Intake worksheet in either of the Explorer programs allows you to test the effect of modifying herbage height on relative availability.

A point of considerable practical importance for those using prediction functions of this type is the need to comply with standard measurement techniques. Taking the GrazFeed program as an example, if techniques for estimating weight and mean height are other than those that are described in the help file, appropriate predictions cannot be expected.

**Selective grazing**

In using estimates of relative ingestibility and availability for the prediction of relative intake, the pasture cannot be treated as if it were a mass of material of uniform quality. Grazing animals select living rather than dead material, younger rather than older, leaf rather than stem and will almost always achieve a diet of higher quality than the mean of that available. For an adequate prediction of relative intake, the herbage in a sward must be classified in a way that corresponds to that in which it is perceived and eaten by the animal. This process is, of course, beyond what can be reasonably solved by simple hand calculations and its complexity is the main reason why models such as that in the GrazFeed decision support tool have been developed.

In this model, the herbage is, conceptually, distributed between six pools, each of fixed mean digestibility (80% to 30%) and it is assumed that the animals will attempt to satisfy their potential intake from each of these pools in succession, starting with the highest digestibility. The extent to which this can be done depends on the relative ingestibility and relative availability of the herbage in each pool. A worked example in Table 23.3 shows how the relative availability is calculated for each pool after adjusting for the proportion of potential intake satisfied by more digestible pools.
From the relative intake for each pool, a cumulative relative intake is calculated and multiplied by the animal's potential intake. In this example, the predicted intake was 77% of the potential intake and the mean digestibility of the diet was 3 percentage units higher than the mean herbage on offer. The size of this difference will increase as the weight of herbage increases and gives greater scope for diet selection.

In semi-arid grazing areas, where the vegetation is very variable and the animals graze only some of the plants, this method for predicting diet digestibility would be inappropriate. The most promising alternative is through the analysis by near infrared spectroscopy of faecal samples from the grazing animals, calibrated against known standards (Coates 1999). However, some meaningful estimate of the relative availability of the feed base is still required for the prediction of relative intake.

Table 23.3 Predicted intake of feed by a lactating Merino ewe with a potential intake of 2.13 kg DM/d and the digestibility of its selected diet from a pasture with 0.8 t DM/ha of green herbage, mean digestibility 70%, and 0.4 t DM/ha dead herbage, mean digestibility 45%. Source: Freer, Moore and Donnelly (2005).

<table>
<thead>
<tr>
<th>Herbage pool</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter digestibility (%)</td>
<td>80</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Relative ingestibility</td>
<td>1.0</td>
<td>0.83</td>
<td>0.66</td>
<td>0.49</td>
<td>0.32</td>
<td>0.15</td>
</tr>
<tr>
<td>Weight of herbage (t DM/ha)</td>
<td>0.24</td>
<td>0.36</td>
<td>0.23</td>
<td>0.16</td>
<td>0.15</td>
<td>0.06</td>
</tr>
<tr>
<td>Relative availability(a)</td>
<td>0.39</td>
<td>0.34</td>
<td>0.11</td>
<td>0.05</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Relative intake</td>
<td>0.39</td>
<td>0.28</td>
<td>0.07</td>
<td>0.02</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>Cumulative relative intake</td>
<td>0.77</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasture intake (kg DM)</td>
<td>1.63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean digestibility of diet(b) (%)</td>
<td>73</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(a\) After adjusting for the proportion of appetite satisfied by more digestible pools

\(b\) Weighted mean for the herbage eaten from all pools

**Dietary preferences**

Animals typically exhibit preferences when given ample choice of feed but it is important to distinguish between preferences and intake. Where the preferences are based on structural features of plants that affect the clearance rate of digesta in the gut, then they can be expected to affect relative ingestibility. On the other hand, there are many cases where differences in smell, taste or tactile stimuli affect the palatability of the feed if animals have free choice, but these preferences are often inconsistent in the field and tend to disappear as the sward becomes sparser. They are usually regarded as having little or no independent effect on the total intake of feed.

**Availability of water**

Lynch et al. (1972) found that the feed intake by sheep grazing improved temperate pastures was not reduced in the absence of drinking water unless they were lactating or the environmental temperature was high. In semi-arid areas, however, the distance that the animals have to walk to water may place a severe constraint on the area that the animals can reach in a grazing day and this problem is exacerbated where the vegetation has a high salt content or when the land close to the water supply has already been denuded (O'Reagain and McMeniman 2002).

**23.4 Supplementary feeding**

When supplements of grain or processed meals are offered to hand-fed animals eating a basal diet of roughage, the intake of roughage is usually depressed. The depression in the dry matter intake of the roughage divided by the dry weight of supplement eaten is called the substitution rate. This depends on the relative quantities and qualities of the supplement and roughage (Dove 2002). For grazing animals, the prediction of the substitution rate is complicated by its interaction with the availability of the pasture. With high quality supplements on high quality abundant pasture,
substitution rates are close to 1.0, but on abundant pastures of only 50 per cent digestibility it may be as low as 0.65 (Alden 1981). As the weight of pasture falls, and with it the intake of un-supplemented pasture, so does the substitution rate (Stockdale 2000).

**Figure 23.5** Predicted substitution rate for a sheep offered 200 g of a supplement of 80% digestibility while grazing a pasture of mean digestibility 70% (solid line) or 50% (dotted line). Source: Freer, Moore and Donnelly (2005).

Because of the obvious complexity in the relationship between supplement and herbage, a set value for substitution rate is unlikely to be satisfactory. The procedure that is used in the GrazFeed program is an integral part of the method for predicting the relative intake of pasture and rests on the simple assumption that the grazing animal will select the supplement before it selects herbage of the same or lower quality (unless the user overrides this assumption). Examples of predicted substitution rates for different pastures over a range of herbage weights are shown in Fig. 23.5.

If the supplement can rectify nutrient deficiencies in the herbage, such as nitrogen or sulphur, which are restricting the activity of the microbial population of the rumen, then the intake of herbage may increase and the substitution rate will be negative (Freer et al. 1988).

### 23.5 Putting it all together

Reference has been made throughout this lecture to the difficulty of predicting the feed intake by grazing animals through simple hand calculations, because of the many interactions between the attributes of the animals, the pasture and possible supplements in any particular situation. Yet this information may be of significant economic importance to a grazer who is uncertain about the need for expensive supplements if a target weight gain or milk yield is to be achieved. The GrazFeed program is an attempt to integrate the factors discussed above and provide sensible predictions for the user. It is also a useful tool for the student to explore how changes to the specifications of pastures and animals affect the predicted intake of feed. These effects may be examined more fully using the plotting routines that allow the interactions between different variables to be predicted.

### Readings

The following readings are available on CD.

Summary

An estimate of the feed intake by grazing animals is the essential starting point for their nutritional management. This estimate depends on a combination of animal and pasture attributes and can be considered as the product of the potential intake by the animal and the relative intake offered by the pasture, as a proportion of potential intake. An animal's potential intake depends on its mature size, its stage of maturity and body condition. It increases markedly during lactation but this increase lags behind the energy needs of the lactating animal. The relative intake offered by the feed depends mainly on its quality and its availability to the animal. We compute relative intake as the product of relative ingestibility, an index of quality factors that affect the rate at which digesta is cleared from the gut, and relative availability, which reflects the effects of herbage mass and height on the ability of the animal to harvest feed in a grazing day. As the prediction of both factors is further complicated by the animal's selective grazing from the sward and the interactions with supplementary feeding, computer models have been developed in an attempt to integrate the processes and provide realistic estimates of feed intake and diet quality.

References


